

**EARLY ATTRITION IN FY 1985:  
THE EFFECTS OF THE  
DELAYED ENTRY PROGRAM,  
ACCESSION MONTH, AND  
ENLISTMENT PROGRAM**

Donald J. Cymrot

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## REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION <b>UNCLASSIFIED</b>			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION / AVAILABILITY OF REPORT		
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE			APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.		
4. PERFORMING ORGANIZATION REPORT NUMBER(S) <b>CRM 86-192</b>			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION <b>Center for Naval Analyses</b>		6b. OFFICE SYMBOL (If applicable) <b>CNA</b>	7a. NAME OF MONITORING ORGANIZATION <b>Office of the Chief of Naval Operations (OP-01)</b>		
6c. ADDRESS (City, State, and ZIP Code) <b>4401 Ford Avenue Alexandria, Virginia 22302-0268</b>			7b. ADDRESS (City, State, and ZIP Code) <b>Navy Department Washington, D.C. 20350-2000</b>		
8a. NAME OF FUNDING / ORGANIZATION <b>Office of Naval Research</b>		8b. OFFICE SYMBOL (If applicable) <b>ONR</b>	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER <b>N00014-83-C-0725</b>		
8c. ADDRESS (City, State, and ZIP Code) <b>800 North Quincy Street Arlington, Virginia 22217</b>			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO. <b>65154N</b>	PROJECT NO. <b>R0148</b>	TASK NO.
					WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) <b>Early Attrition in FY 1985: The Effects of the Delayed Entry Program, Accession Month, and Enlistment Program</b>					
12. PERSONAL AUTHOR(S) <b>Donald J. Cymrot</b>					
13a. TYPE OF REPORT <b>Final</b>		13b. TIME COVERED FROM TO		14. DATE OF REPORT (Year, Month, Day) <b>September 1986</b>	
				15. PAGE COUNT <b>60</b>	
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Attrition, DEP (Delayed Entry Program), Enlisted personnel, Enlistment program, Naval personnel, Personnel selection, Qualifications, Recruiting, Recruits, Retention (general), SCREEN (Success Chances for Recruits Entering the Navy), Selection, Survival (personnel), Tables (data)		
<b>05</b>	<b>09</b>				
<b>05</b>	<b>10</b>				
19. ABSTRACT (Continue on reverse if necessary and identify by block number)  This research memorandum examines the effects of three factors on attrition from the Navy within 2 and 6 months of shipping for recruits who entered in FY 1985. These three factors are participation in the Delayed Entry Program (DEP), month of shipment, and enlistment program. The results indicate that DEP recruits have lower attrition than direct shippers, that attrition among direct shippers is higher in months with high accession rates, and that attrition rates vary by enlistment program.					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS				21. ABSTRACT SECURITY CLASSIFICATION <b>Unclassified</b>	
22a. NAME OF RESPONSIBLE INDIVIDUAL				22b. TELEPHONE (Include Area Code)	
				22c. OFFICE SYMBOL	

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8 October 1986

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Encl: (1) CNA Research Memorandum 86-192, "Early Attrition  
in FY 1985: The Effects of the Delayed Entry  
Program, Accession Month, and Enlistment Program,"  
September 1986

1. Enclosure (1) is forwarded as a matter of possible interest.
2. This Research Memorandum examines attrition within the first 6 months of service of enlisted personnel who entered the Navy in FY 1985. The study analyzes three indicators of attrition-- participation in the Delayed Entry Program, the month of accession into the Navy, and the recruit's program of enlistment. This report is part of an ongoing study of enlistments.

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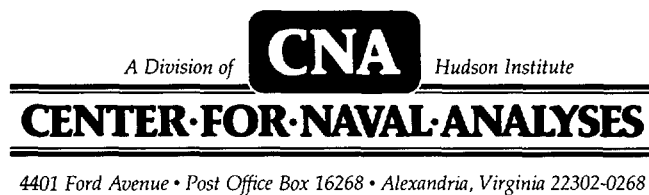
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Donald J. Cymrot

*Naval Manpower, Planning, and Logistics Division*



## ABSTRACT

This research memorandum examines the effects of three factors on attrition from the Navy within 2 and 6 months of shipping for recruits who entered in FY 1985. These three factors are participation in the Delayed Entry Program (DEP), month of shipment, and enlistment program. The results indicate that DEP recruits have lower attrition than direct shippers, that attrition among direct shippers is higher in months with high accession rates, and that attrition rates vary by enlistment program.

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## INTRODUCTION

Attrition can be costly to the Navy when it occurs early in a recruit's term of service. Most recruits spend the first few months of service in training. All non-prior-service recruits are initially sent to boot camp<sup>1</sup> for 2 months. After completion of boot camp, new recruits go to either apprenticeship training for 1 month or A-school. The average A-school pipeline lasts about 4 months.<sup>2</sup> Once in the fleet, training may continue. Most recruits receive some on-the-job training before they become fully productive. All this training represents a considerable investment on the part of the Navy. Attrition during or shortly after this period of training leaves the Navy with no return on its investment.

The Navy tries to avoid this costly attrition through screening. Potential recruits who are judged to have a high probability of leaving are not allowed to enlist. The basic tool for estimating this probability is the SCREEN (Success Chances for Recruits Entering the Navy) table.<sup>3</sup> The table divides potential recruits by age, educational status, mental group, and gender. It provides the probability that males with a specific set of characteristics complete 1 year of service. Potential recruits with SCREEN scores less than 70, that is, an estimated attrition probability of more than 30 percent, are not permitted to enlist. The SCREEN table currently in use is based on experiences from the 1977 recruit cohort.

Recently, SCREEN methodology was reexamined using data from FY 1978 to FY 1984 [6]. The purpose of this reevaluation was to validate the original SCREEN table with more recent data and to find other factors that influence attrition. The factors under consideration are different from those included in the original SCREEN analysis in that they deal with the way in which a recruit enters the Navy rather than personal characteristics.

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<sup>1</sup>Technically known as the Recruit Training Course or RTC.

<sup>2</sup>A pipeline is a sequence of courses that leads to the awarding of a rating. The average pipeline includes 2.3 courses [1].

<sup>3</sup>The background analysis used as a basis for the SCREEN tables was done at CNA. For a detailed description of this work, see [2] through [5].

The new variables are whether accession is through the Delayed Entry Program (DEP) and which enlistment program or type of contract the recruit chooses. The addition of these new characteristics in SCREEN methodology should help further control attrition costs. This memorandum extends the reexamination in two ways. First, it analyzes the most recent data (from FY 1985), and second, it considers the effect of another new variable--the month of accession.

## BACKGROUND OF THE ISSUES

This analysis deals with three separate but related variables: participation in the Delayed Entry Program, month of accession into the Navy (or shipment month), and enlistment program. These variables are related because their values are determined at the time of enlistment. They all involve the transition from civilian to military life, and, unlike personal characteristics, they are either under the Navy's control or the Navy can influence the recruit's choices. These choices are important because they could affect either the probability of attrition or the size of the Navy's loss in case of attrition.

### DELAYED ENTRY PROGRAM

Enlistees enter the Navy either through the Delayed Entry Program or as direct shippers. The DEP offers potential recruits the opportunity to enlist several months in advance of shipping, that is, before the beginning of their terms of service. A direct shipper's term of service begins shortly after his enlistment.

Having recruits enter the Navy through the DEP has several advantages. The Navy can better plan its accessions and perhaps better coordinate accessions and training; recruiters can be more selective in choosing among potential recruits without the pressure to meet a quota by an imminent deadline; and the delay between enlistment and shipment gives recruits time to consider their career choice. The effect of the DEP on attrition may be particularly felt through the latter two of these advantages.

All recruits must have a minimum SCREEN score to be permitted to enlist, but not all potential recruits have the same score. If the DEP gives recruiters more time to be selective, they may be able to find potential recruits with higher SCREEN scores. The higher average SCREEN scores should be translated into lower overall attrition. Whether the DEP is serving this selection function could be determined by comparing the SCREEN



scores or simply the characteristics of DEP recruits and direct shippers. If, on average, DEP recruits are more likely to have characteristics associated with low attrition, the DEP is serving this selection function.

The DEP may also serve a filtering function. Although the SCREEN tables do identify some significant factors that influence the propensity to quit, they are not perfect predictors of future attrition. Even recruits in the best cell on the SCREEN table are expected to suffer some attrition. Some factors that influence attrition cannot be captured with SCREEN-type characteristics. Recruiters may not be fully aware of the circumstances under which a potential recruit decided to enlist.<sup>1</sup> Some people enlist without having fully thought through the implications of their career choice. When there is a lag between enlisting and shipping, recruits have a chance to ponder this decision. Some change their minds, and quit before shipping. Attrition from the DEP is numerically significant [7]. The DEP cannot be expected to be a perfect attrition filter because some recruits may not fully understand the implications of military service until they confront a drill instructor or spend a week on a ship in rough seas,<sup>2</sup> but the time in the DEP may filter out some recruits with relatively high propensities to quit before they ship. Although the Navy may not like any kind of attrition, attrition from the DEP is better than attrition early in the term of service because it costs less.

This filtering function is independent of the selection function. Evidence for the existence of filtering requires adjustments for differences in characteristics between DEP recruits and direct shippers. If attrition is significantly lower among DEP recruits, adjusting for other characteristics, the DEP serves a filtering function. Evidence about filtering is of particular importance because with filtering, the DEP provides information about attrition not provided for by SCREEN methodology.

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<sup>1</sup>Researchers who design SCREEN-like systems have even less information.

<sup>2</sup>Also, some recruits will face unexpected changes in personal circumstances, such as the death of a family member or a marriage, that could influence their decision to remain in the Navy.

## MONTH OF ACCESSION

In FY 1985, monthly accessions varied from about 4,700 in March to 7,100 in August. Although this range is about average for the past few years, it is smaller than it had been earlier. For example, in FY 1977, monthly accessions ranged from about 3,400 in December to about 10,000 in August. Variations in monthly accessions are of interest because they may affect the cost of training. Training facilities<sup>1</sup> must have the capacity to train recruits during the peak months, but meeting peak demand means there is excess capacity during much of the rest of the year. This excess capacity is costly.

Eliminating the variation in training rates is one possible strategy for reducing training costs. One way to reduce the capacity of training facilities is to level load recruits (i.e., ship about the same number of recruits each month). While level loading reduces facilities costs, it could also affect the quality of recruits and thereby attrition.<sup>2</sup> In the past the quality of recruits has not been the same each month.<sup>3</sup> Even if recruiting standards are maintained and accessions are raised in certain months, level loading could affect the overall attrition if there are monthly variations in attrition rates. Monthly variation could occur if there are unobservable differences in characteristics or seasonal factors that make training March recruits, for instance, different from August ones. In considering the costs and benefits of level loading, it is necessary to examine variations in monthly attrition rates, adjusting for observed characteristics.

---

<sup>1</sup>Facilities include personnel and equipment as well as buildings and bases.

<sup>2</sup>Other ways are to delay A-school training of some recruits by shipping them to the fleet for several months between boot camp and A-school, and to let them sit around until seats become available in A-school. Both of these alternatives can be costly. If recruits are sent to the fleet, they must first receive apprenticeship training and then be transported to and from a training base. If the recruits have no duties, the Navy incurs the opportunity cost of their time.

<sup>3</sup>Evidence of monthly variation in quality is provided below.

## ENLISTMENT PROGRAMS

The effect of enlistment programs on attrition rates is somewhat different from that of the DEP, as a screening device, or the month accession. The questions involving the DEP or the accession month is whether a variable has an independent effect on the attrition rate. The question here is whether attrition rates across programs are different, regardless of other factors that influence attrition, and whether that variation follows an efficient pattern.

Attrition rates should vary across programs because the amount that the Navy invests in recruits, although substantial in all cases, does vary significantly across programs. For example, general-duty recruits receive 1 month of apprenticeship training after boot camp, and avionics technicians go to A-school for over 10 months. Given the differences in the size of the investment, the Navy should have different standards for different contracts. The Navy recognizes differences in investment across programs by obligating participants in different programs for different lengths of time. The bigger the investment, the longer the obligation. Contracts are not immutable, however; there is still considerable attrition prior to the end of contracts. Although the Navy cannot absolutely prevent early attrition, it should be concerned with distribution of attrition across enlistment programs. An efficient system for screening recruits would tolerate higher attrition in programs with lower investment costs.

## FY 1985 EARLY ATTRITION DATA

This study examines early attrition for recruits who entered the Navy during the 1985 fiscal year. The data come from merging two files: the Enlisted Master Record (EMR) and the FY 1985 contract and attrition data from the Defense Manpower Data Center.<sup>1</sup> The merged data set contains 70,013 observations.<sup>2</sup> The data set follows recruits through March 1986. All recruits could have served at least 6 months, and those who entered in beginning of the fiscal year (October 1984) could serve as much as 18 months. These data contain three types of variables: personal characteristics, monthly accession and attrition information, and enlistment program. A description of the personal characteristics is provided next, followed by a more detailed description of the other variables.

Table 1 shows the means of some personnel characteristics for the entire data set and then separated by stayers and leavers. A leaver is anyone who has left the Navy as of March 1986; this definition is more encompassing than the definition used in the analysis below, which focuses on 2-month and 6-month survival rates. Someone who entered in October 1984 and left in March 1986 is counted as a leaver in table 1, but would be considered a stayer in the analysis of the determinants of the 2- and 6-month survival rates. The table also shows the 2-month and 6-month survival rates among all recruits. These survival rates imply that 8.7 percent of all recruits left the Navy within the first 2 months of service, and 13.7 percent of all recruits left within the first 6 months of service.

Because all the variables, with the exception of length of service, equal either 0 or 1 (i.e., they are dummy variables), the numbers on the table are the proportion of recruits in each category. The table shows that a higher proportion of stayers are high school diploma graduates, in mental groups 1 or 2, and age 17 or 18. In previous SCREEN analyses, recruits with these three characteristics had the highest survival probabilities. Throughout the

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<sup>1</sup>See [8] for details of the EMR.

<sup>2</sup>This data set also includes information about 301 Navy veterans. These recruits are not non-prior-service and so are excluded from the analysis.

TABLE 1

VARIABLE MEANS FOR  
NON-PRIOR-SERVICE RECRUITS  
FOR FY 1985

Key variables	Means		
	All	Stayers	Leavers
Length of service (months)	9.738	10.761	4.075
Survival for			
2 months	.913	-	-
6 months	.863	-	-
Education			
Some college	.023	.024	.018
H.S. diploma	.854	.870	.766
GED	.059	.051	.102
Less than H.S.	.064	.055	.114
Mental Group			
1	.049	.052	.035
2	.337	.345	.296
3U	.221	.216	.248
3L	.286	.285	.292
4A	.104	.100	.125
4B + 4C	.002	.002	.005
Age			
17-18	.283	.290	.244
19-20	.424	.425	.420
21 or older	.293	.286	.336
White	.798	.795	.816
Male	.899	.902	.885
Waiver	.306	.303	.329
Number of observations	70,013	59,297	10,716

rest of this analysis, recruits with these three characteristics are referred to as high quality. The term high quality is in reference to only the survival probability and has no other implication.

## DELAYED ENTRY PROGRAM

In fiscal year 1985, 71.3 percent of all recruits entered the Navy through the Delayed Entry Program. The formal distinction between DEP recruits and direct shippers rests on the month of enlistment and the month of shipment. DEP recruits ship in a different month from their contract month, and direct shippers ship in the same month as their contract month.<sup>1</sup> According to the data, DEP recruits had higher survival rates at both 2 and 6 months than those recruits who were direct shippers. The survival rate at 2 months was 92 percent for DEP recruits and 89 percent for direct shippers. At 6 months, the DEP survival rate was 89 percent, which was nearly 5 percentage points higher than the rate for direct shippers.

The two possible reasons for the differences in survival rates are the filtering effect and the selection effect. In filtering, the time provided to DEP recruits between enlistment and shipment enables them to think about their decision to join the Navy. In this case, the DEP filters out some of the recruits who would have been early leavers before they officially join the Navy. Those recruits who have gone through the DEP filter are less likely to leave than direct shippers. In selection, those recruits who enter the Navy through the DEP are of higher quality than direct shippers. The higher quality of DEP recruits may be the result of: choices made by recruiters about whom to place in the DEP and whom to ship, standards set by the Recruiting Command for entering the DEP, or decisions about the timing of enlistment made by recruits. For instance, high school seniors who are likely to be high-quality recruits (i.e., 17- and 18-year-old diploma graduates) spend the time from enlistment until graduation in the DEP. In this case, the higher survival probabilities of the DEP recruits merely reflects the higher quality of the recruits. These two interpretations are not mutually exclusive. Higher quality recruits could enter the DEP but, having had time to ponder their future, may be less likely to leave.

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<sup>1</sup>These definitions are standard in CNA data sets. The Navy sometimes defines direct shippers as recruits who ship within 2 days of enlistment. The data provided to CNA by the Navy do not permit researchers to identify shipments within 2 days of enlistment.

Evidence for the selection explanation is provided in table 2. The data are divided between DEP recruits and direct shippers, and the mean values for education level, mental group, and age variables are shown. The high-quality categories of HS diploma or some college, mental groups 1 or 2, and age 17 and 18 contain a higher proportion of DEP recruits.

TABLE 2  
CHARACTERISTICS OF  
DEP RECRUITS AND DIRECT SHIPPERS

Variables	DEP	Direct Shippers
2-month survival	.921	.895
6-month survival	.893	.848
Some college	.025	.013
HS diploma	.894	.755
GED	.041	.101
Less than HS	.040	.122
MG 1	.057	.031
MG 2	.356	.292
MG 3U	.208	.252
MG 3L	.287	.285
MG 4A	.090	.138
MG 4BC	.003	.002
Age 17-18	.289	.268
Age 19-20	.433	.400
Age 21+	.278	.332

Determining whether the DEP also serves as a filter requires estimating survival probabilities for the two groups, assuming other characteristics are the same. An appropriate technique in this situation is a maximum-likelihood estimator for a qualitative variable. The distribution used in this study is a logistic one. A more complete discussion of logit analysis is provided in appendix A. Table 3 shows the effect of recruit characteristics



on the 2- and 6-month survival probabilities. These are independent effects; they adjust for other characteristic differences.<sup>1</sup>

TABLE 3  
EFFECTS OF  
RECRUIT CHARACTERISTICS ON  
2- AND 6-MONTH  
SURVIVAL PROBABILITIES

Variables	2 months	6 months
HS Diploma <sup>a</sup>	-1.3	-2.0 <sup>d</sup>
GED <sup>a</sup>	-8.7 <sup>d</sup>	-13.2 <sup>d</sup>
Less than HS <sup>a</sup>	-8.8 <sup>d</sup>	-13.4 <sup>d</sup>
MG 2 <sup>b</sup>	-1.0	-1.3
MG 3U <sup>b</sup>	-2.2 <sup>d</sup>	-3.0 <sup>d</sup>
MG 3L <sup>b</sup>	-3.8 <sup>d</sup>	-5.2 <sup>d</sup>
MG 4A <sup>b</sup>	-6.6 <sup>d</sup>	-9.7 <sup>d</sup>
MG 4BC <sup>b</sup>	-3.2	-24.0 <sup>d</sup>
Age 17-18 <sup>c</sup>	0.9 <sup>d</sup>	1.2 <sup>d</sup>
Age 21+ <sup>c</sup>	-1.6 <sup>d</sup>	2.6 <sup>d</sup>
DEP	1.2 <sup>d</sup>	2.4 <sup>d</sup>

*a.* Relative to recruits with some college.

*b.* Relative to recruits in mental group 1.

*c.* Relative to recruits age 19-20.

*d.* Variable is statistically significant  
at 5-percent level.

The differences shown in table 3 are in percentage points. If two recruits have identical characteristics except one has less than a high school education and the other has some college, their estimated 2-month survival probabilities differ by nearly 9 percentage points, and the 6-month probabilities differ by about 13 percentage points. There is little difference

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<sup>1</sup>Other characteristics, including enlistment program and month of accession, are included in the underlying estimates that were used to calculate these effects.

between the survival probabilities for recruits with a high school diploma and those with some college, and between recruits with general equivalency diplomas (GEDs) and those with less than a complete high school education, but there is a relatively large difference between high school diploma graduates and GEDs. These results are only partially new. In the original SCREEN tables, diploma graduates are predicted to have higher survival rates than GEDs, but GEDs are predicted to have higher survival rates than high school recruits. According to these estimates, the latter result did not hold in FY 1985.

The effect of participation in the DEP, although smaller than most of the other effects shown in the table, is statistically significant. At 2 months, the difference is about 1 percentage point, and at 6 months, it is 2.4 percentage points. These differences are the filtering effect, which is about one third of the total difference in survival rates at 2 months (i.e., 1 percentage point out of 2.8) and about half of the difference at 6 months.

## MONTH OF ACCESSION

### ACTUAL MONTHLY PATTERN

In FY 1985, accessions into the Navy followed a bimodal pattern that appears to be influenced by the school year. The monthly accession rate, which is the percent of annual accessions that begin active duty in a particular month, was higher in the summer and winter months (at the end of the academic semesters) than in the spring and fall.

Attrition<sup>1</sup> from the Navy also varied from month to month. The attrition rate is  $(1 - s)$ , where  $s$  is the survival rate. The attrition rate at 2 months of service hit its peak in May at 10.3 percent and was at its trough in December at 7.7 percent. The 6-month rate ranged from 10.6 percent in September to 13.8 percent in April. The actual monthly accession and attrition rates for FY 1985 are shown in table 4.

Figure 1 compares the rate of accession to the rate of attrition. Accessions and attrition appear to move in the opposite direction. During the spring months, when the accession rate is low, the attrition rate is relatively high; during the late summer, when accessions peaked, attrition is relatively low. The simple correlation between the 2-month attrition rate and the accession rate is  $-.29$ , and the simple correlation between the 6-month attrition rate and the accession rate is  $-.38$ .<sup>2</sup> This simple analysis suggests that level loading would lead to an increase in attrition because it would require shifting accessions from months when attrition is low to months when it is high.

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<sup>1</sup>The analysis in this section is cast in terms of attrition instead of survival for ease of exposition. Accession and attrition rates are closer to one another, and this closeness facilitates the drawing of the figures.

<sup>2</sup>The 2-month correlation coefficient is statistically significant at the 40-percent level, and the 6-month coefficient is statistically significant at the 25-percent level.

TABLE 4

ACCESSION AND ATTRITION RATES BY  
MONTH OF ACCESSION

Accession month	Rate of accession	2-month attrition	6-month attrition
Oct	7.5	8.8	11.5
Nov	7.3	8.3	11.8
Dec	7.5	7.7	10.6
Jan	8.7	8.7	11.6
Feb	8.9	8.2	11.4
Mar	7.5	8.3	11.9
Apr	6.7	9.7	13.8
May	7.4	10.3	13.7
Jun	9.4	9.3	12.7
Jul	9.4	9.0	12.4
Aug	10.1	8.1	11.3
Sep	9.5	8.1	11.6

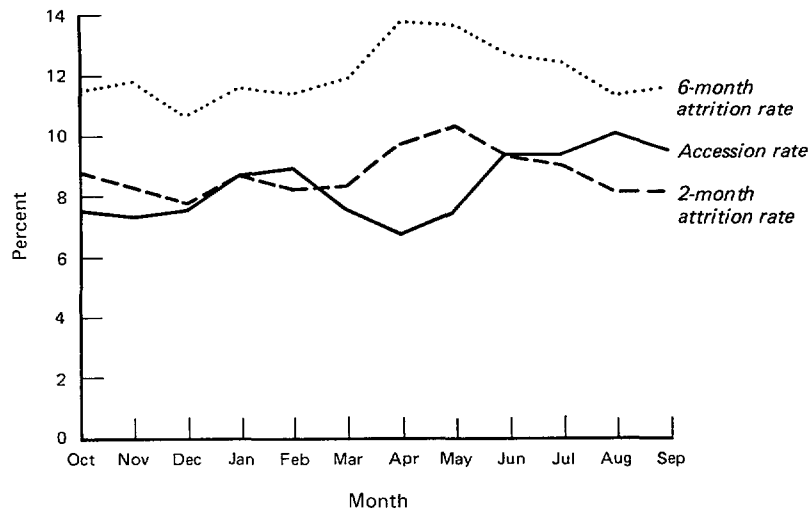


FIG. 1: MONTHLY ACCESSION AND ATTRITION RATES

## ADJUSTING FOR RECRUIT QUALITY

One constant theme in research on attrition from the Navy that has been reaffirmed earlier in this paper is that attrition depends on recruit quality. Higher quality recruits have a lower rate of attrition than other recruits. The previous comparison between the monthly accession and attrition rates involves actual rates without making allowances for differences in the quality of recruits. Although such comparisons are informative, they tell only part of the story. If recruit quality varies over the year, the effect of monthly accessions may be either enhanced, reduced, or reversed as a result of taking quality into account. If the Navy can influence the timing of recruit quality, either through the DEP program, the timing of recruiting efforts, or the use of enlistment bonuses, attrition rates should be corrected for quality effects before being compared to the accession rate.

As table 5 shows, the quality of recruits follows a seasonal pattern. Both the percent of recruits with high school diplomas (HS DIPL) and the percent of recruits age 17 or 18 (Age 17-18) peak during the summer months. The percent of recruiting in mental groups 1 and 2 (MG I II) are highest during December and January. Using information in table 5, figure 2 displays the cyclical pattern of the quality. The correlation between the accession rate and the high school diplomas variable is .5 and with the age variable is .8. In the months in which a relatively large number of recruits enter the service, the quality of those recruits is above average.

Using the logit regressions shown in appendix A, the monthly attrition rates can be corrected to take into account differences among recruits across accession month.<sup>1</sup> Table 6 shows the adjusted 2- and 6-month attrition rates.

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<sup>1</sup>This correction is made so that the average adjusted rate equals the average actual rate. The relative monthly rates are determined using the coefficients on the monthly dummy variables shown on table A-1.

TABLE 5

PERCENT OF RECRUITS WITH  
SELECT CHARACTERISTICS  
BY MONTH OF ACCESSION

Month	MG I II	HS DIPL <sup>a</sup>	Age 17-18
Oct	.37	.90	.11
Nov	.38	.90	.13
Dec	.41	.91	.12
Jan	.42	.89	.11
Feb	.39	.85	.12
Mar	.39	.82	.15
Apr	.38	.81	.16
May	.39	.82	.17
Jun	.36	.86	.50
Jul	.37	.91	.53
Aug	.39	.92	.53
Sep	.39	.92	.53

*a.* Includes recruits with some college.

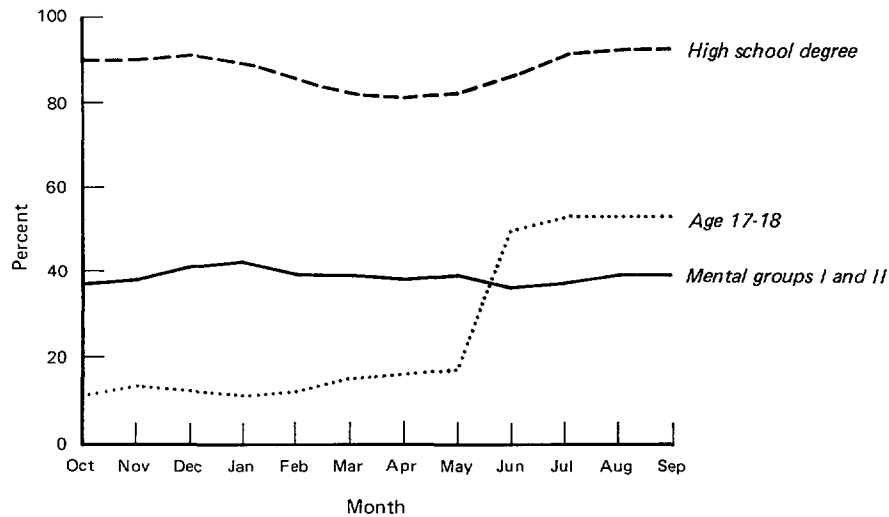


FIG. 2: PERCENT OF MONTHLY ACCESSIONS WITH  
SELECT CHARACTERISTICS

TABLE 6

ADJUSTED MONTHLY  
ATTRITION RATES

Accession month	2-month rate	6-month rate
Oct	9.0	11.7
Nov	8.4	11.9
Dec	7.5	11.5
Jan	8.3	11.2
Feb	7.6	10.7
Mar	7.7	11.1
Apr	8.6	12.4
May	9.4	12.6
Jun	9.5	12.9
Jul	9.6	13.3
Aug	8.9	12.6
Sep	8.9	12.6

The biggest effects of the adjustment are the downward shift of attrition in the winter and spring and the upward shift during the summer. The peak attrition month changes from May to July at 2 months and April to July at 6 months. The difference between the adjusted and actual rates for both 2- and 6-month attrition is shown in figure 3.

This adjustment affects the correlation between the accession rate and the attrition rate. For the 2-month rate, the correlation is .33, and for the 6-month rate, the correlation is .34.<sup>1</sup> Even though the correlations are statistically significant at only low levels by conventional standards, and the number of observations is small, the results are, nonetheless, of interest.

<sup>1</sup>These coefficients are statistically significant at the 30-percent level, assuming a bivariate normal distribution. The assumption of a bivariate normal affects the standard error of the correlation coefficient, but not the coefficient itself. Thus, even if the assumption is incorrect, it does not affect the direction of the relationship, only the confidence interval. This assumption will be examined by applying bootstrapping techniques in future research.

The shift in the attrition pattern was sufficient to switch the sign on the correlation coefficient from negative to positive, while maintaining approximately the same level of statistical significance. When adjustments are made for quality, high accession months are associated with relatively poor attrition performance.

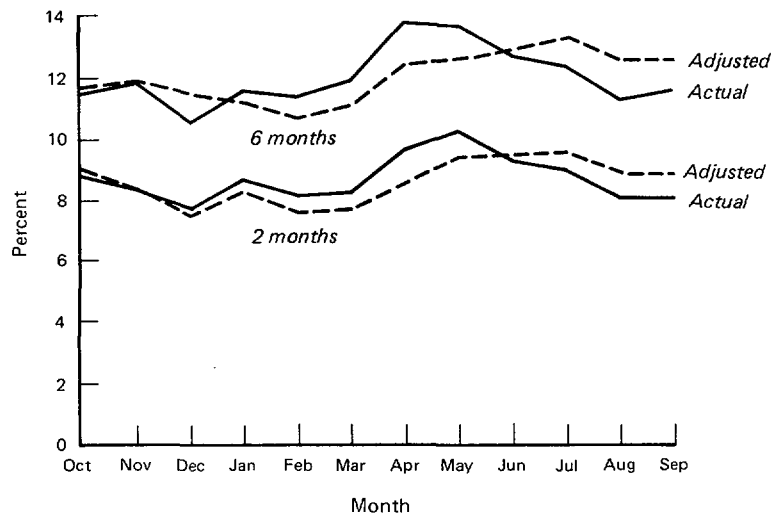


FIG. 3: ACTUAL AND ADJUSTED ATTRITION RATES

## PARTIAL ADJUSTMENTS

Making an adjustment in attrition rates for recruit quality is a “thought experiment.” In a thought experiment, the researcher assumes that some change in the observations is possible and then works through the implications of that change. The value of the thought experiment depends upon



the reasonableness of the assumption. In the case described previously, equalizing the quality of recruits across the months of the year is assumed to be possible. There may, however, be a problem with equalizing at least one dimension of quality. The percent of 17-to-18-year-old recruits follows a highly seasonal pattern (three times higher during the summer than the rest of the year). Most 17-to-18-year-olds are high school diploma graduates, and high school graduations are generally in either May or June. To equalize quality over the year, some of the recent high school graduates would have to delay shipping until the following spring. By then, however, many of the 18-year-olds will have turned 19. Thus, because of the natural progression of the calendar, it may not be possible to find enough 17-to-18-year-olds in the spring months to equalize quality over the year.

If the original experiment is unrealistic, an alternative can be considered. Suppose that accessions by age group follow the established pattern (shown in table 2), but other dimensions of quality—education level and mental groups—can be equalized across months of the year. In other words, the summer months do have higher quality recruits but only because more 17-to-18-year-olds access during those months. The monthly attrition rates for this partially adjusted case are shown in table 7. When these partially adjusted attrition rates are correlated with total accessions, the correlation coefficients are  $-.03$  for 2-month attrition and  $-.11$  for 6-month attrition. These coefficients, which are not statistically different from 0, indicate that the number of accessions has no effect on total attrition.

Table 8 summarizes the correlation coefficients between the total monthly accessions and the three measures of monthly attrition rates: actual, partially adjusted, and fully adjusted. The differences among these cases emphasize the importance of the assumption about equalizing recruit quality across months. The results, and any policy recommendations that might come from them, depend on the extent to which quality can be shifted. If quality can be shifted completely, attrition could be lowered by increasing accessions during the spring and decreasing accessions during the summer. If quality can be shifted only partially, there is nothing to gain from equalizing monthly accessions.

TABLE 7

PARTIALLY ADJUSTED  
MONTHLY ATTRITION RATES

Accession month	2-month rate	6-month rate
Oct	9.4	12.3
Nov	8.7	12.4
Dec	7.8	11.0
Jan	8.7	11.8
Feb	8.0	11.2
Mar	8.0	11.5
Apr	8.9	12.8
May	9.7	13.0
Jun	9.2	12.4
Jul	9.2	12.7
Aug	8.6	12.0
Sep	8.5	12.1

TABLE 8

CORRELATION COEFFICIENTS BETWEEN  
MONTHLY ACCESSIONS AND  
ACTIVE DUTY ATTRITION RATES

Accession rates at	Actual	Partially adjusted	Fully adjusted
2 months	-.29	-.03	.33
6 months	-.31	-.11	.34

## ATTRITION RATES OF DEP RECRUITS AND DIRECT SHIPPERS

This section seeks further insights into the the relationship between accession and attrition rates by examining separate monthly attrition rates for DEP recruits and direct shippers. Table 9 shows the total number of active-duty accessions for DEP recruits and direct shippers by accession month. Accessions of direct shippers and DEP recruits move in opposite directions. For example, April is the month with the fewest DEP recruit accessions and the most direct shipper accessions. This pattern is consistent with the idea that direct ship accessions are used to fulfill recruiting quotas that could not otherwise be filled through the DEP.

TABLE 9

### MONTHLY ACTIVE-DUTY ACCESSIONS

Accession month	DEP recruits	Direct shippers
Oct	4,182	1,096
Nov	3,743	1,360
Dec	3,763	1,481
Jan	4,145	1,976
Feb	4,264	1,935
Mar	3,270	1,969
Apr	2,621	2,075
May	3,334	1,836
Jun	4,808	1,783
Jul	4,711	1,875
Aug	5,678	1,427
Sep	5,373	1,308

Table 10 shows actual, partially adjusted and fully adjusted monthly attrition rates for DEP recruits and direct shippers.<sup>1</sup> In the fully adjusted case the characteristics of DEP recruits in each month are assumed to be equal to the average for all DEP recruits, and the characteristics of direct shippers in each month are assumed to be equal to the average for all direct shippers. In the partially adjusted case, the average age of recruits for each group is assumed to be the same as the actual average age of recruits in that month for that group, but the remaining characteristics for each group are assumed to be the same across all months.

Not surprisingly, the attrition rates for direct shippers are higher than the rates for DEP recruits. Figure 4 shows a representative case of the monthly pattern of these attrition rates. Although the rates for both groups vary from month to month, they do not track together. In nearly all the cases shown in table 10, the trough occurs in December; the peak in the direct shipper cases tends to occur later in the fiscal year than the peak for DEP recruits. The largest differences occur in the summer.

The relationship between sets of accession and attrition rates can be summarized by examining the correlation between them. Table 11, which shows the correlation coefficients, is broken down into three sections. The first section shows the correlation between the total monthly accessions and attrition rates for DEP recruits and direct shippers at 2 and 6 months. The middle section shows the correlation between the total active-duty accessions from the DEP and the attrition rates. The bottom section shows the correlation between total accessions among direct shippers and the attrition rates.

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<sup>1</sup>The logit coefficients that underlie the fully and partially adjusted rates are shown in appendix B. One difference between the logits used to generate tables 7 and 8 and the ones used to generate table 10 is that the ones in table 10 do not include variables about the enlistment program. These were omitted because the addition of 12 interactive terms significantly increased the computational cost of this procedure, which is already substantial. The covariance between the seasonal interactive terms and the enlistment programs is low, so the omitted variable bias effects are inconsequential. The procedure used to determine the attrition rates from the logit coefficients is the same as had been used previously.

TABLE 10  
ATTRITION RATES FOR  
DEP RECRUITS AND DIRECT SHIPPERS  
(2 MONTHS AND 6 MONTHS)

<b>2 Months</b>						
Accession month	DEP recruits			Direct shippers		
	Actual	Adjusted		Actual	Adjusted	
		Part	Full		Part	Full
Oct	8.2	8.2	8.1	10.9	11.2	11.1
Nov	8.0	8.1	8.0	9.1	9.5	9.3
Dec	7.3	7.3	7.0	8.8	9.2	9.0
Jan	7.7	7.7	7.5	10.6	10.9	10.7
Feb	7.6	7.3	7.1	9.3	9.3	9.1
Mar	7.7	7.5	7.3	9.2	9.4	9.2
Apr	9.2	8.5	8.3	10.3	10.6	10.4
May	9.6	9.1	8.9	11.4	11.5	11.3
Jun	8.0	7.7	8.2	12.5	11.9	12.5
Jul	8.2	8.4	8.9	10.9	10.4	11.1
Aug	7.4	7.6	8.0	10.6	10.4	11.1
Sep	7.2	7.3	7.7	11.8	11.4	12.1

<b>6 Months</b>						
Accession month	DEP recruits			Direct shippers		
	Actual	Adjusted		Actual	Adjusted	
		Part	Full		Part	Full
Oct	10.6	10.6	10.4	15.0	15.5	15.3
Nov	11.0	11.0	10.8	14.1	14.7	14.5
Dec	9.9	9.9	9.6	12.3	12.9	12.6
Jan	10.2	10.2	9.8	14.6	15.1	14.7
Feb	10.4	10.4	9.6	13.7	13.9	13.5
Mar	10.3	10.3	9.7	14.5	14.8	14.5
Apr	12.8	12.8	11.4	15.0	15.6	15.2
May	12.3	12.3	11.2	16.2	16.4	16.0
Jun	10.9	10.9	11.0	17.6	16.7	17.6
Jul	11.0	11.4	12.0	15.9	15.4	16.2
Aug	10.1	10.4	10.9	16.0	15.9	16.8
Sep	10.2	10.2	10.7	17.3	16.8	17.7

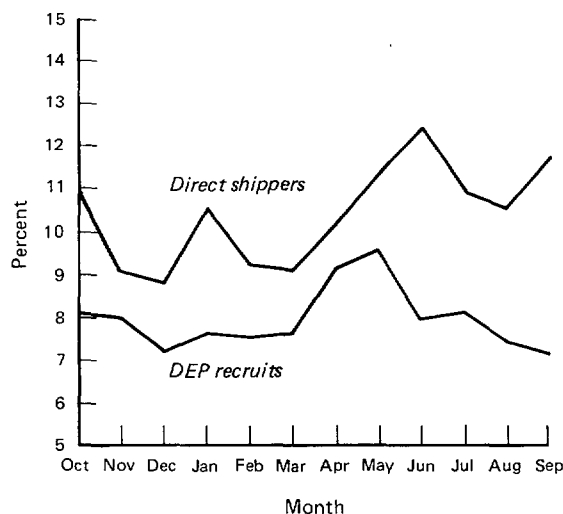


FIG. 4: ACTUAL 2-MONTH ATTRITION RATES FOR DEP RECRUITS AND DIRECT SHIPPERS

With regard to both total accessions and DEP recruit accessions, the correlation coefficient with DEP recruit attrition is either negative or zero, and the coefficient with direct shipper attrition is positive and statistically significant (that is, at the 30-percent level). With regard to the direct shipper accessions, the correlation coefficient with DEP recruit attrition is positive for the unadjusted cases, but near zero in all other cases.

The results from this table display no clear pattern for attrition among DEP recruits. The lack of a pattern is not surprising since none was found among all recruits, and DEP recruits represent a large majority of all recruits. Whether the attrition rate for these recruits is correlated with the accession rate depends on the assumptions that are made about the quality of recruits across months.

TABLE 11

CORRELATION COEFFICIENTS BETWEEN  
TOTAL, DEP, AND DIRECT-SHIP MONTHLY  
ACCESSIONS AND DEP AND DIRECT-SHIP  
ACTIVE-DUTY ATTRITION RATES

Attrition rates at	Unadjusted	Partially adjusted	Fully adjusted
<b>Total Accessions</b>			
2 months			
DEP	-.54 <sup>a</sup>	-.41 <sup>b</sup>	.02
DS	.48 <sup>b</sup>	.26	.51 <sup>a</sup>
6 months			
DEP	-.51 <sup>a</sup>	-.35 <sup>c</sup>	.15
DS	.52 <sup>a</sup>	.34 <sup>c</sup>	.57 <sup>a</sup>
<b>DEP Accessions</b>			
2 months			
DEP	-.63 <sup>a</sup>	-.41 <sup>b</sup>	.02
DS	.46	.28	.52 <sup>a</sup>
6 months			
DEP	-.60 <sup>a</sup>	-.38 <sup>c</sup>	.12
DS	.49 <sup>b</sup>	.34 <sup>c</sup>	.57 <sup>a</sup>
<b>DS Accessions</b>			
2 months			
DEP	.36 <sup>c</sup>	.17	.04
DS	-.09	-.12	-.18
6 months			
DEP	.40 <sup>c</sup>	.18	.03
DS	-.07	-.09	-.18

a. Statistically significant at the 10-percent level.

b. Statistically significant at the 20-percent level.

c. Statistically significant at the 30-percent level.

A clearer pattern emerges from the results for direct shippers. In this case, attrition among direct shippers is positively correlated with the accession rates among all recruits and DEP recruits, but not with the accession rate among direct shippers. This result is particularly important because it is robust (i.e., it holds despite other adjustments for recruit quality.) Direct shippers who enter active duty in months of high DEP accessions are of poorer quality even after adjustments are made for other known quality characteristics such as education level or mental group. There are several possible reasons for this relationship. Because direct shippers are the last to enlist within an accession cohort, they may be subjected to the worst conditions within the cohort. When accessions are high, training facilities are the most crowded. The relative treatment of the direct shippers may deteriorate during these times, which may make their adjustment to the Navy more difficult. Also, due to the crowding, recruits may either have to wait for training or have their training plans changed. The delays or changes in plans may discourage new recruits and encourage attrition.

Crowding may not be the only reason for the increased attrition. When shipments in a month increase, the marginal recruits are shipped directly instead of being put in the DEP. If the marginal recruits chosen to ship directly are similar to recruits more likely to abrogate their contracts while in the DEP, the shifting results in an increase in active-duty rate, particularly among direct shippers.<sup>1</sup> One final reason for the relatively poor attrition record in June and July is that recruits in these months go through boot camp during the middle of the summer, which may be particularly odious.

## IMPLICATIONS FOR RECRUITING POLICY

The major results of the analysis on accession month are related to the results of the analysis in the previous section on the Delayed Entry Program. These results have shown, once again, that DEP recruits are more

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<sup>1</sup>Support for this hypothesis would result if the characteristics of direct shippers in months with high accession rates were similar to those who quit the DEP.



likely to remain in the Navy than direct shippers, but this analysis adds a new dimension to the findings. It has shown that the relative advantage of DEP recruits over direct shippers is particularly high in the summer months, when both overall accessions and DEP accessions are high. A relatively high attrition rate for this group implies that the training cost to the Navy of direct shippers in the summer is relatively high. It takes more summertime direct shippers to produce productive sailors than either DEP recruits or direct shippers during the rest of the year.

Although the results of this research do not provide strong evidence for or against complete level loading of accessions, they do indicate that marginal shifting of direct ship recruits away from the summer months would lead to some cost saving. The most straightforward way of implementing such a shift in accessions would be to place a higher percent of summer enlistees into the DEP and allowing fewer to ship directly. To accomplish such a shift, some changes would have to be made in recruiting policies. One suggestion would be to place limits or perhaps impose a complete ban on direct shipments during the summer months. Potential enlistees who sign up during the summer would then be forced into the DEP for some period. Placing a limit on direct shipments, however, could cause problems for recruiters trying to meet monthly accession goals. These problems could be overcome by reducing recruiting goals during the summer months and raising them during the rest of the year, or by providing recruiters with some additional credit for bringing people into the DEP during the summer months.

## ENLISTMENT PROGRAMS

In FY 1985, there were ten enlistment programs. Advanced Electronics Field (AEF), Advanced Technology Field (ATF), and Nuclear Field (NF) all provide entry into high-tech ratings and carry 6-year service obligations. In general, these programs have higher entry standards and have had higher survival rates. The Five-Year Obligation (5YO) program is primarily for construction ratings. In the Active Mariners (AM) program, the recruit is obligated to 3 years of active service and 2 years of reserve service. The Seafarers (SF), School Guarantee (SG), and TAR Enlistment Program (TEP) all have 4-year obligations. The Direct Procurement Enlistment Program (DPEP) provides for entry into the military at above the starting paygrade level. It includes individuals who got occupational schooling prior to enlistment and, consequently, require no A-school training. There are also some miscellaneous programs.

## RECRUIT CHARACTERISTICS

Table 12 shows the number of accessions into each program in FY 1985 and the percent of these recruits with the most attractive characteristics (in terms of survival). There are some striking differences in the quality of recruits across programs. The programs with 6-year obligations, (NF, AEF, and ATF) attract a higher percent of quality recruits, with the Nuclear Field having the highest percent. A program such as the Seafarers program, which provides the least amount of training, has relatively low percentages in all categories and the lowest percent of upper mental groups.

This variation does not result from a random assignment of recruits to different programs; it is by design. Some programs, particularly the high-tech programs, have entry standards that go beyond the basic enlistment standards. These standards ensure that the recruits are capable of understanding the training but may have the side benefit of identifying recruits who are less likely to leave the Navy prematurely.

TABLE 12  
RECRUITS AND SELECT CHARACTERISTICS  
BY PROGRAM OF ENTRY

Program	Number	MG I II	HS DIPL <sup>a</sup>	AGE 17-18
AEF	8,081	.73	.94	.26
AM	8,791	.23	.83	.34
ATF	1,582	.83	.89	.23
DPEP	63	.54	.94	.22
5YO	2,071	.36	.92	.22
NF	5,920	.97	.99	.38
SF	17,630	.17	.87	.27
SG	24,426	.32	.86	.26
TEP	786	.41	.80	.36
MISC	663	.35	.71	.29

*a.* Also includes those recruits with some college.

Unlike the previous analysis, the focus here is not independent effects. The relevant question is whether recruits into the high (training) cost programs are more likely to remain in the Navy. It has already been shown that these programs have higher quality recruits than other programs. That 6-year-obligation programs have a relative high quality of recruits is not surprising because these programs have higher enlistment standards than other programs. Having selected high-quality recruits to enter, however, the issue then is whether these recruits are more likely to remain in the service.

#### SURVIVAL PROBABILITIES BY PROGRAM

Table 13 shows the estimated survival probabilities for the ten enlistment programs. These probabilities are calculated from the estimated logit

equation shown in appendix C.<sup>1</sup>

TABLE 13

SURVIVAL PROBABILITIES  
BY ENLISTMENT PROGRAM

Program	2 months	6 months
AEF	93.3	91.1
AM	89.7	85.5
ATF	92.2	90.1
DPEP	95.2	88.9
5YO	91.2	88.4
NF	96.2	94.6
SF	90.6	86.0
SG	90.6	88.0
TEP	90.1	87.9
MISC	92.2	77.8

The program with the highest survival probability is the nuclear field. At 2 months, the survival probability for NF recruits is about 4 percentage points higher than for the average recruit, and at 6 months it is about 6 percentage points higher. Both AEF and ATF recruits, who also have 6-year obligations, have survival probabilities that are significantly above average.

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<sup>1</sup>The logit estimates in appendix A can be used to determine the effect of adjusting for quality on the survival probability by programs. After adjusting for quality, nuclear field recruits have above-average survival probabilities at both 2 and 6 months. Other statistically significant differences include AEF with above-average probabilities at 6 months, SG recruits with above-average probabilities at 2 months, and the recruits in miscellaneous programs with below-average probabilities at both 2 and 6 months. The statistical significance of these quality adjusted probabilities indicates that there are still other factors that determine the survival probabilities. These factors could be related to the actual treatment of recruits from different programs once in the Navy, to economic factors affecting the opportunity cost of recruits, or to some unobserved characteristics (unobserved to the researcher but not necessarily the recruiter) that differentiate recruits in different programs.

Estimates of the average investment cost per recruit by program for FY 1985 are not available. If, however, it is assumed that programs with the longest service obligations have the highest training investments, it is possible to do a simple test of the efficiency of the system for screening recruits. Using the survival probabilities shown in table 13, the correlation coefficient between the survival rate and the length of obligation is .57 at 2 months and .67 at 6 months. The positive correlation suggests the recruiting system is relatively efficient with respect to the allocation of recruits among programs. Programs with longer service obligations have higher survival rates.

## CONCLUSIONS AND RECOMMENDATIONS

This memorandum addresses the early attrition of recruits who entered the Navy during fiscal year 1985. It analyzes three separate aspects of the early attrition issue: the effects of the Delayed Entry Program, the month of accession, and the enlistment program.

The DEP was shown to have both a filtering and a selection effect on attrition. Recruits who enter the Navy through the DEP are, on average, of higher quality than those who enter as direct shippers. This difference in quality indicates that either recruiters are more selective in allowing potential enlistees to enter the DEP than to enlist as direct shippers or perhaps there is some self-selection on the part of recruits. Even adjusting for quality differences, however, DEP recruits survive at higher rates. This result indicates that entering through the DEP provides recruits an opportunity to consider their choice, and some people quit prior to shipping. Attrition from the DEP is less expensive than attrition from active duty, so this filtering function benefits the Navy.

The month of accession also affects the rate of attrition because of seasonal fluctuation. Attrition peaks during the spring months, but if the quality of recruits is taken into account, attrition peaks during the summer. The attrition rate, adjusted for quality differences, is correlated to the accession rate. When separate attrition rates are estimated for DEP recruits and direct shippers, the attrition rate for direct shippers is shown to be correlated to the accession rate, but the attrition rate for DEP recruits is not. This result indicates that if quality can be maintained, shifting direct shippers during the summer months into the DEP would decrease attrition.

The enlistment program also influences the attrition rate. The attrition rate is higher in programs with shorter service obligations. This relationship indicates that the screening of recruits by program is relatively efficient. This conclusion, however, is based on the untested assumption that there is a direct relationship between the level of investment in a recruit and the length of the service obligation.

The results of this analysis show that (1) the Delayed Entry Program serves a useful filtering function, (2) if recruit quality can be maintained, level loading of recruits could reduce attrition, and (3) the screening of recruits across enlistment programs is relatively efficient. Although these conclusions are important, some qualifications must be attached to them. The data in this paper are limited to 1 year. FY 1985 is generally viewed as an average recruiting year, neither as bad as the late seventies nor as good as the early eighties. It is uncertain whether these results are sensitive to the recruiting climate. Additional testing with more data under different recruiting environments would improve the strength of the evidence. Also, given the limit of 1 year of data, some of the results are based on correlations with only 12 observations. Again, additional data would increase the number of monthly observations and increase the level of confidence in the results. Because of availability of data, this analysis is limited to the determinants of 6-month survival rates. Previous analyses extend to a year and beyond. Six months is still relatively early in the typical recruit's term of service, and comparisons over longer time periods may be more fruitful in making policy decisions. Nonetheless, this analysis reveals certain trends that are worth investigating further.

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## APPENDIX A

### LOGIT ESTIMATES OF 2- and 6-MONTH SURVIVAL RATES

The probability changes discussed in the main text on the DEP and month of accession are based on logit estimates. The estimation procedure is maximum-likelihood in which the underlying probability distribution of survival is assumed to be distributed logistically. The form of a logit regression is as follows:

$$P(y = 1) = \frac{1}{1 + e^{-(\alpha + \beta x_i)}}, \quad (\text{A-1})$$

where  $y=1$  means the recruit leaves the Navy during the time period of interest; the  $x_i$ s are independent variables, which in this case includes personal characteristics, participation in the DEP, program of entry, and month of accession, and the  $\beta$ 's are regression coefficients that can be used to determine the effect of the independent variables on the probability of survival. Table A-1 shows the results of the estimation for both 2- and 6-month attrition rates.

The coefficients shown in table A-1 are neither slopes, as they would be in an ordinary least-squares regression, nor probability changes. Equation A-2 is used to calculate the independent effect of a variable on the survival probability.

$$P(y = 0) = \frac{1}{1 + e^{\alpha + \beta x_i}}. \quad (\text{A-2})$$

The only difference between equations A-1 and A-2 is the sign of the exponential term. Changing the sign from a minus to a plus has the same effect as subtracting the attrition probability from 1. Equation A-2 is evaluated using the two discreet values of the variable in question and the mean values of all other variables. For example, consider the change in the probability of leaving the Navy within 2 months resulting from participation in the DEP. First evaluate the sum of the values of  $\beta x_i$  for all other variables except

the DEP. This task is accomplished by multiplying column 1 by column 2 in table A-1, excluding the values for the DEP. This sum equals -2.309. It is substituted into equation A-2 and gives a probability for those not in the DEP of .090. Now assume the value of the DEP variable is 1; add the value of the DEP coefficient, -.159, to the sum. The sum of the  $\beta x_i$ s is -2.468. Substituting into equation A-2 gives the probability of leaving for DEP participants, which is .078. The difference between the two is 1.2 percentage points.

TABLE A-1

LOGIT ESTIMATES OF  
2- AND 6- MONTH ATTRITION PROBABILITIES  
(t statistics in parentheses)

Independent variables	Means	2-month rates	6-month rates
Intercept	1	-2.818 (19.14)	-2.44 (19.01)
LTHS	.064	.861 (7.56)	.980 (9.86)
GED	.059	.849 (7.69)	.963 (9.99)
HS Diploma	.854	.176 (1.72)	.210 (2.36)
MG2	.337	.134 (1.64)	.132 (1.87)
MG3U	.221	.277 (3.25)	.282 (3.81)
MG3L	.286	.462 (5.40)	.468 (6.30)
MG4A	.104	.696 (7.48)	.774 (9.64)
MG4BC	.002	.364 (1.21)	1.462 (7.75)
Age 17-18	.283	-.125 (3.40)	-.120 (3.75)
Age 21+	.293	.212 (6.42)	.251 (8.74)
Male	.899	-.282 (6.35)	-.273 (6.97)
White	.798	.273 (7.54)	.229 (7.38)
Waiver	.307	-.050 (1.66)	-.038 (1.43)

TABLE A-1 (Continued)

Independent variables	Means	2-month rates	6-month rates
DEP	.713	-.159 (4.50)	-.236 (7.78)
AEF	.115	-.050 (.86)	-.147 (2.91)
AM	.126	.083 (1.66)	-.029 (.68)
ATF	.023	.067 (.65)	-.086 (.95)
DPEP	.001	-.541 (.91)	-.038 (.10)
5YO	.030	.090 (1.08)	-.017 (.23)
NF	.085	-.504 (6.15)	-.512 (7.38)
SG	.349	.130 (3.57)	-.024 (.74)
TEP	.011	.115 (.92)	-.146 (1.28)
MISC	.009	-.251 (1.69)	.479 (4.83)

TABLE A-1 (Continued)

Independent variables	Means	2-month rates	6-month rates
Nov	.073	-.078 (1.11)	.019 (.30)
Dec	.075	-.195 (2.70)	-.126 (1.99)
Jan	.087	-.088 (1.29)	-.047 (.78)
Feb	.089	-.177 (2.60)	-.104 (1.75)
Mar	.075	-.166 (2.34)	-.064 (1.03)
Apr	.067	-.043 (.60)	.063 (1.01)
May	.074	.048 (.70)	.085 (1.41)
Jun	.094	.058 (.87)	.112 (1.92)
Jul	.094	.078 (1.16)	.142 (2.40)
Aug	.101	-.005 (.07)	.082 (1.39)
Sep	.095	-.007 (.10)	.085 (1.42)
$\chi^2$		871	1458

## APPENDIX B

### LOGIT ESTIMATES OF ATTRITION RATES BY MONTH OF ACCESSION AND PARTICIPATION IN THE DEP

## APPENDIX B

### LOGIT ESTIMATES OF ATTRITION RATES BY MONTH OF ACCESSION AND PARTICIPATION IN THE DEP

This appendix explains the procedure for calculating the adjusted attrition rates, shown in table 10 of the main text, from the logit coefficients shown in table B-1. This procedure involves substituting the logit coefficients into the logit formula. The logit formula in this case is

$$P(y = 1) = \frac{1}{1 + e^{-(\alpha_o + \beta x_i + \beta x_i x_d + \beta x_j)}}, \quad (\text{B-1})$$

where the  $x_i$ s are the monthly dummy variables,  $x_d$  is the DEP interaction variable, and the  $x_j$ s are the personal characteristics. In calculating the adjusted attrition rates, the personal characteristics are all assumed to be equal to their means. Let

$$\alpha = \alpha_o + \beta x_j, \quad (\text{B-2})$$

where the  $x_j$ s equal the means shown in table B-1. At 2 months,  $\alpha$  equals -2.236, and at 6 months  $\alpha$  equals -1.999. The logit formula may be rewritten as

$$P(y = 1) = \frac{1}{1 + e^z}, \quad (\text{B-3})$$

where

$$z = -(\alpha + \beta x_i + \beta x_i x_d). \quad (\text{B-4})$$

The monthly attrition rates for direct shippers or DEP recruits are determined by evaluating the logit formula after substituting the appropriate values for the  $x_i$ s and  $x_d$ . The  $x_i$  equals 1 for the month in which the rate is being calculated and 0 for all other months, and  $x_d$  equals 1 for DEP recruits and 0 for direct shippers.

TABLE B-1

LOGIT ESTIMATES OF  
2- AND 6-MONTH ATTRITION  
BY MONTH OF ACCESSION  
AND PARTICIPATION IN DEP  
(t statistics in parenthesis)

Independent variables	Means	2-month rates	6-month rates
Intercept		-2.927 (17.72)	-2.583 (17.94)
Nov	.073	-.191 (1.40)	-.060 (.52)
Dec	.075	-.232 (1.73)	-.224 (1.91)
Jan	.087	-.045 (.37)	-.043 (.40)
Feb	.089	-.220 (1.75)	-.144 (1.33)
Mar	.075	-.207 (1.65)	-.065 (.06)
Apr	.067	-.073 (.60)	-.007 (.54)
May	.074	.022 (.18)	.058 (.54)
Jun	.094	.137 (1.13)	.167 (1.57)
Jul	.094	-.001 (.01)	.072 (.67)
Aug	.101	-.003 (.03)	.110 (.98)
Sep	.095	.097 (.74)	.174 (1.53)



TABLE B-1 (Continued)

Independent variables	Means	2-month rates	6-month rates
Oct*DEP	.060	-.197 (1.74)	-.265 (2.66)
Nov*DEP	.053	-.022 (2.49)	-.159 (1.67)
Dec*DEP	.054	-.116 (1.17)	-.132 (1.36)
Jan*DEP	.059	-.235 (1.00)	-.288 (3.47)
Feb*DEP	.061	-.114 (1.04)	-.210 (2.49)
Mar*DEP	.047	-.103 (1.27)	-.279 (3.20)
Apr*DEP	.037	-.103 (1.04)	-.153 (1.78)
May*DEP	.048	-.120 (1.27)	-.238 (2.85)
Jun*DEP	.069	-.321 (3.56)	-.365 (4.63)
Jul*DEP	.067	-.092 (.99)	-.180 (2.25)
Aug*DEP	.081	-.203 (2.01)	-.321 (3.74)
Sep*DEP	.077	-.347 (3.41)	-.405 (4.62)

TABLE B-1 (Continued)

Independent Variables	Means	2-month Survival	6-month Survival
MG2	.337	.267 (3.34)	.237 (3.43)
MG3U	.221	.486 (5.96)	.453 (6.43)
MG3L	.286	.684 (8.51)	.677 (9.76)
MG4A	.104	.897 (10.37)	.994 (13.36)
MG4B 4C	.002	.522 (1.74)	1.737 9.38
Less than HS	.064	.909 (8.03)	1.039 (10.52)
GED	.059	.875 (7.95)	1.007 (10.48)
HS Diploma	.854	.170 (1.67)	.199 (2.23)
Age 17-18	.283	-.123 (3.29)	-.120 (3.69)
Age 21+	.293	.220 (6.66)	.259 (9.01)
White	.798	.274 (7.56)	.224 (7.22)
Male	.899	-.314 (7.23)	-.324 (8.47)
Waiver	.307	-.055 (1.80)	-.395 (1.59)
$\chi^2$		793	1378

There are two problems in using these equations to determine adjusted monthly attrition rates. First, equation A-2 contains the implicit assumption that the quality-type characteristics of DEP recruits and direct shippers are the same. The analysis in the section on the DEP showed that,

in fact, DEP recruits are of higher quality than direct shippers. Therefore, using the same value for  $\alpha$  for both DEP recruits and direct shippers captures only the filtering effect of the DEP and tends to underestimate the difference between the two groups. Second, in maximum-likelihood procedures such as logit, the estimated equation is not constrained to go through the mean of the sample. Therefore, using the coefficients shown in table B-1, the average of the predicted attrition rates is not necessarily equal to the average of the actual attrition rate.<sup>1</sup> In other words, by simply using the average value for all the variables, the logit equation would not predict the actual attrition rate.

Neither of these problems affects the correlation between the monthly accession rate and the adjusted monthly attrition rate because in both cases the attrition rates are shifted up or down proportionately. The reason for making these further adjustments is to avoid a potentially confusing situation where the adjusted rates are consistently higher or lower than the actual rates.

This further adjustment ensures that the average adjusted attrition rates equal the actual rates. DEP recruits and direct shippers are treated separately so that the average of the adjusted rates for each group equals the average of the actual rates for that group. The mechanism for making the adjustment is to change the value of  $\alpha$ . First, separate  $\alpha$ s are set for DEP recruits ( $\alpha_{DEP}$ ) and direct shippers ( $\alpha_{ds}$ ). Then, these  $\alpha$ s are calibrated so that the average attrition rate is weighted by the monthly accession rate for that month. The calibration is done by trial and error using a Lotus 123 spreadsheet program. For the 2-month accession rates,  $\alpha_{DEP}$  equals -2.232, and  $\alpha_{ds}$  equals -2.081. For 6-month accession rates,  $\alpha_{DEP}$  equals -1.889, and  $\alpha_{ds}$  equals -1.711.

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<sup>1</sup>This problem does not arise in ordinary least-squares estimates because the estimated curve is required to go through the mean of the sample. That is, if the mean values for the independent variables are substituted into the estimated equation, it predicts the mean value for the dependent variable. In other words, if the attrition rates were estimated using ordinary least squares (which would be inappropriate for reasons discussed in appendix A), the predicted attrition rate would equal the actual attrition rate.

Some examples of the calculations should provide useful in understanding this procedure. Since October is omitted in the estimation equation, the attrition rate for direct shippers in October is the easiest to calculate. All terms in  $z$ , except  $\alpha$ , equal zero. The 2-month attrition rate in this case is

$$P(y = 1) = \frac{1}{1 + e^{2.081}} = .111.$$

As another example, the 2-month attrition rate for DEP recruits entering in June is

$$P(y = 1) = \frac{1}{1 + e^{-(-2.232 + .137 - .321)}} = .082.$$

These adjusted attrition rates (multiplied times 100) are shown in table 10 of the main text. The remainder of the fully adjusted attrition rates shown in that table are calculated using the same procedure.

## APPENDIX C

### LOGIT ESTIMATES OF 2- AND 6-MONTH SURVIVAL RATES BY ENLISTMENT PROGRAM

The estimates in table C-1 are used as a basis for calculating the changes in the survival rate probabilities shown in table 13 of the main text. The method for converting the regression coefficients into survival probabilities is discussed in the previous appendixes. The omitted program is the Seafarers.

TABLE C-1  
LOGIT ESTIMATES OF  
ATTRITION RATES  
BY ENLISTMENT PROGRAMS

Program	2-month rates	6-month rates
Intercept	-2.269 (87.81)	-1.813 (83.59)
AEF	-.369 (7.17)	-.518 (11.58)
AM	.109 (2.51)	.039 (1.06)
ATF	-.204 (2.10)	-.393 (4.53)
DPEP	-.727 (1.23)	-.267 (.67)
5YO	-.065 (.79)	-.215 (2.99)
NF	-.976 (13.35)	-1.043 (17.02)
SG	.006 (.19)	-.176 (6.01)
TEP	.063 (.52)	-.172 (1.54)
MISC	-.195 (1.32)	.557 (5.80)
$\chi^2$	332	554